Electronic Version
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Claims

[c1] A method of providing power integrity at a watt-hour meter, the method comprising the steps of:
suppressing transient voltages at the input to the watt-hour meter;
monitoring the resistance of an earth ground conductor in circuit communication with the watt-hour meter;
monitoring the current of the earth ground conductor of the watt-hour meter;
monitoring the voltage of the earth ground conductor of the watt-hour meter; and
displaying the results of the suppressing and monitoring steps on a status display.

[c2] The method of claim 1, wherein the monitoring steps are performed substantially continuously.

[c3] The method of claim 1, wherein the step of suppressing transient voltages further comprises:
receiving an AC transient voltage at an input to the watt-hour meter that exceeds a predetermined voltage limit; and
redirecting the received voltage to a neutral line of the watt-hour meter.

[c4] The method of claim 3, wherein the step of redirecting the received voltage to the neutral line of the watt-hour meter further comprises:
providing a voltage limiting device connected in parallel across a hot line and a neutral line of the watt-hour meter;
providing a thermal limiting device connected in series with the voltage limiting device;
providing a fuse connected in series with the voltage limiting device; and
providing a radio frequency filter connected in parallel across the thermal limiting device and the voltage limiting device.

[c5] The method of claim 4, wherein the voltage limiting device is a metal oxide varistor.

[c6] The method of claim 4, wherein the thermal limiting device is a thermistor.

[c7] The method of claim 4, wherein the radio frequency filter is a capacitor.

[c8] The method of claim 3, wherein the predetermined voltage limit is 271 volts peak.

[c9] The method of claim 1, wherein the step of monitoring

the earth ground resistance of the earth ground cable of the watt-hour meter further comprises:
providing a fixed voltage pulse;
coupling the fixed voltage pulse to a drive transformer;
establishing a current flow through the earth ground cable responsive to the output of the drive transformer;
providing a sense transformer;
transforming the current flowing through the earth ground cable into a corresponding voltage;
filtering the resistance signal of unwanted frequencies;
comparing the corresponding voltage to at least one predetermined voltage limit; and
communicating the comparing step results to the status display.

[c10] The method of claim 9, wherein the step of providing a fixed voltage pulse further comprises:
providing a 12 volt DC supply; and
providing a timer circuit in circuit communication with the supply to establish the fixed voltage pulse.

[c11] The method of claim 9, wherein the step of comparing the corresponding voltage to a predetermined voltage limit further comprises:
filtering the corresponding voltage to eliminate noise.

[c12] The method of claim 9, wherein the step of comparing

the corresponding voltage to a predetermined voltage limit further comprises:

providing a first voltage comparator, the first voltage comparator changing state when the corresponding voltage exceeds a 25 ohm ground resistance condition;

providing a second voltage comparator, the second voltage comparator changing state when the corresponding voltage is less than a 300 ohm ground resistance condition;

communicating the first voltage comparator state and the second voltage comparator state to the display.

[c13] The method of claim 1, wherein the step of monitoring the earth ground current of the earth ground conductor of the watt-hour meter further comprises:

providing a sense transformer;

transforming the current flowing through the earth ground cable into a corresponding voltage;

filtering the signal of unwanted frequencies;

comparing the corresponding voltage to a predetermined voltage limit; and

communicating the results of the comparing step to the display when the corresponding voltage exceeds the predetermined voltage limit.

[c14] The method of claim 1, wherein the step of monitoring the earth ground voltage of the earth ground cable of the

watt-hour meter further comprises:
providing a metal ground probe, the probe positioned in the ground in close proximity to the watt-hour meter;
measuring the voltage between the metal ground probe and a neutral line of the watt-hour meter; and
communicating the results of the measuring step to the display when the voltage between the metal ground probe and the neutral line exceeds a predetermined voltage limit.

[c15] The method of claim 14, wherein the predetermined voltage limit is 5 volts AC.

[c16] The method of claim 14, wherein the step of measuring the voltage between the metal ground probe and the neutral line of the watt-hour meter further comprises:
providing an optically isolated circuit in circuit communication with the metal ground probe and a neutral line of the watt-hour meter.

[c17] The method of claim 16, wherein the optically isolated circuit comprises a light emitting diode in circuit communication with a light sensitive transistor.

[c18] The method of claim 1, wherein the step of displaying the results of the suppressing and monitoring steps on a status display, further comprises:

providing a visual indicator on the status display.

[c19] The method of claim 1, further comprising:
providing an audible indicator responsive to the results of the suppressing and monitoring steps.

[c20] A watt-hour meter protection device comprising:
a transient voltage suppression circuit to provide protection from transient conditions at the input to the watt-hour meter;
an earth ground resistance monitor to monitor the resistance of an earth ground conductor of the watt-hour meter;
an earth ground current monitor to monitor the presence of current on the earth ground conductor of the watt-hour meter;
an earth ground voltage monitor to monitor the presence of voltage on the earth ground conductor of the watt-hour meter;
a status display, the status display in circuit communication with the transient voltage suppression circuit, the resistance monitor, the voltage monitor and the current monitor.

[c21] The device of claim 20, wherein the transient voltage suppression circuit further comprises:
a voltage limiting device;

a thermal limiting device connected in series with the voltage limiting device;

a fuse connected in series with the voltage limiting device; and

a radio frequency filter connected in parallel across the thermal limiting device and the voltage limiting device.

[c22] The device of claim 21, wherein the voltage limiting device is a metal oxide varistor.

[c23] The device of claim 21, wherein the thermal limiting device is a positive temperature coefficient thermistor.

[c24] The device of claim 21, wherein the radio frequency filter is a capacitor.

[c25] The device of claim 20, wherein the earth ground resistance monitor further comprises:

a sensor circuit further comprising a drive transformer and a sense transformer;

a fixed voltage pulse circuit to induce a fixed voltage pulse onto the driver transformer;

the earth ground cable in circuit communication with the drive transformer and the sense transformer, the earth ground cable responsive to a voltage output from the drive transformer to produce a related current in the earth ground cable and a corresponding voltage output

signal in the sense transformer; a filter network for removing unwanted frequencies,

a first voltage comparator in circuit communication with the output of the filter network, the first voltage comparator changing state when the output voltage exceeds a first predetermined value corresponding to a first predetermined ground resistance condition, the output of the first voltage comparator supplied to the status display; and

a second voltage comparator in circuit communication with the output of the sense transformer, the second voltage comparator changing state when the output voltage exceeds a second predetermined value corresponding to a second predetermined ground resistance condition, the output of the second voltage comparator supplied to the status display.

[c26] The device of claim 25, wherein the fixed voltage pulse circuit further comprises:

a direct current voltage supply;

a timer circuit in circuit communication with the voltage supply, the timer circuit to establish the fixed voltage pulse.

[c27] The device of claim 26, wherein the fixed voltage pulse circuit further comprises:

a filter circuit to eliminate noise in the voltage output of

the drive transformer.

[c28] The device of claim 26, wherein the first predetermined ground resistance condition is 25 ohms.

[c29] The device of claim 26, wherein the second predetermined ground resistance conditions is 300 ohms.

[c30] The device of claim 20, wherein the earth ground current monitor further comprises:
a current sense transformer;
a frequency filter network; and
a third voltage comparator in circuit communication with the output of the filter network, the output of the third voltage comparator changing state when the output voltage exceeds a the third predetermined value corresponding to a predetermined current condition, the output state of the third voltage comparator supplied to the status display.

[c31] The device of claim 30, wherein the predetermined current condition is 1 amp of 60 Hz AC current.

[c32] The device of claim 20, wherein the earth ground voltage monitor further comprises:
a metal earth ground probe, the probe positioned in the ground in close proximity to the watt-hour meter, the metal earth ground probe in circuit communication with

a neutral line of the watt-hour meter; and
a measurement circuit to measure the voltage between the metal earth ground probe and the neutral line of the watt-hour meter, the measurement results communicated to the status display when the voltage between the metal ground probe and the neutral line exceeds a predetermined voltage limit.

[c33] The device of claim 32, wherein the measurement circuit further comprises an optically isolated circuit.

[c34] The device of claim 33, wherein the optically isolated circuit further comprises a light emitting diode in circuit communication with a light sensitive transistor.

[c35] The device of claim 32, wherein the predetermined voltage limit is 5 volts AC.

[c36] The device of claim 20, wherein the status display further comprises visual indicators.

[c37] The device of claim 20, wherein the status display further comprises audible indicators.

[c38] A watt-hour meter protection device comprising:
a transient voltage suppression circuit to provide protection from transient conditions at the input to the watt-hour meter;

an earth ground resistance monitor to monitor the resistance of an earth ground conductor of the watt-hour meter;

an earth ground current monitor to monitor the presence of current on the earth ground conductor of the watt-hour meter;

an earth ground voltage monitor to monitor the presence of voltage on the earth ground conductor of the watt-hour meter;

a metal ground probe, the probe positioned in the ground in close proximity to the watt-hour meter, the metal ground probe in circuit communication with a neutral line of the watt-hour meter;

a status monitor display, the status monitor display in circuit communication with the transient voltage suppression circuit, the resistance monitor, the voltage monitor and the current monitor.